THE PROBLEM OF AGRICULTURAL ECOLOGY.

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"We must come universally to the practice of producing seed adapted not only to the region, but to the individual locality."—C. S. Brand, United States Department of Agriculture.

Too little attention has been paid up to the present to the study of environment in agriculture. As yield is the result of a compromise between specific productivity and resistance to the most adverse phenomena, will it be possible to come to any conclusion relative to data for sowing, choice of variety, etc., when one of the terms of the compromise is absolutely or almost completely disregarded? It will be impossible, just as it is impossible for a tailor to make a suit for a man whom he has never seen and whose measure he has never taken.

By agricultural ecology we mean the study of the action of the different meteorological factors (in the atmosphere and soil) and the discovery of the extent to which it expresses itself with relation to the plant as regards the development and the yield. A more exact representation of environment will be of great use to the agriculturist and help him in all his endeavors leading to a better adaptation of culture to climate and soil. Researches conducted and data worked out by the method proposd aim at establishing for each plant cultivated (in the different points of its area of distribution) the genetic factors which rule its behavior in relation to environmental conditions and the exterior agents or group of agents which display the greatest influence on yield revealing the characters of susceptibility or resistance determined by the genetic factors.

Observations with reference to the relations between environmental factors and plant growth should be taken during the critical periods after determination of the optimum date for sowing. Frequency and intensity of adverse phenomena in connection with the critical periods will determine the degree of resistance that is necessary to overcome unfavorable conditions and produce a good harvest. Such determinations are not only useful, but absolutely necessary, to carry out plant breeding on a rational basis.

Collection of data.—To obtain meteorological figures and biological data for comparison, observations on meteorological factors and biological researches will be conducted on parallel lines in the same place.

Elaboration of data.—Leading to the determination of (1) critical periods; (2) frequency and intensity of the different meteorological phenomena; (3) phenological means.

Points 1–3 enable one exact biometeorological balance to be established.

Application of data (worked out as above).—Leading to the following results: (1) Choice of the variety most suitable to the given conditions; (2) best dates (5) for sowing; (3) most suitable cultural operations to escape unfavorable climatic conditions and best times for carrying them out; (4) a practical knowledge of environment for the plant-breeder to enable him to obtain the type (3) most likely to succeed under actual meteorological conditions.

The fact that the negative action of the meteorological factors has a decided influence yearly on the decrease in crop yield has for a very long time past attracted the attention of students and practical workers. In the year 286 B. C. Theophrastus asserted that *annus fructificat non tellus*, and was followed by Columella, Vergil, Varro, and a hundred others during the Greek-Roman period, the middle age, and up to recent times. On the other hand, there is no agricultural country where the nature phraseology does not include proverbial sayings with special reference to the relationship between the critical periods of plant growth and weather.

At the present time observations are being made in connection with agricultural meteorological work almost everywhere. Before the war and revolution there was in Russia an excellent agricultural meteorological service, organized by Prof. P. I. Brounov, the founder of agricultural meteorology, and periodical publications on the subject were issued.

Many countries publish periodical information on weather and crops, and a considerable quantity of information has been accumulated, but without system or coordination. It is not really sufficient to make parallel observations on the development of a plant and meteorological factors unless some method is followed which will allow the utilization of the data thus accumulated in connection with the improvement of agriculture and the practical solution of the problems closely connected with agricultural meteorology.

Following up the works of preceding authors (Brounov, Warren, Smith, Gauer) and utilizing the present writer's own theory, I have combined all the elements and data into a new system of research.

For this purpose the following points, must be established: (1) The critical period; (2) phenoscopic averages; (3) the percentages of probability of the various meteorological phenomena for each 10-day period during the season of growth; (4) decrease of the yield caused by various unfavorable conditions (this decrease measures the intensity of action of the different unfavorable factors).

GENERAL RULES TO BE OBSERVED WHEN MAKING BIOMETEOROLOGICAL OBSERVATIONS.

Critical period.—This, for instance, as regards rain, is the term applied to the short interval of vegetative growth during which the plant absolutely requires a certain minimum of atmospheric precipitation.

If during the critical period the total rainfall is less than the minimum needed for the normal development of the plant, the crop will be small, even if there is an abundance of rain throughout the rest of the vegetative period. In the same way, should the requirements of the plant be satisfied during the critical period, the crop will be large, even if the rainfall is relatively scanty and badly distributed throughout the remainder of the vegetative period.

One of the critical periods of cereals falls within the 20 days before heading, and if at this time the rain is not sufficient to keep the soil moisture above a certain limit the grain crop will be seriously reduced.

This is, in fact, the moment when the plant is most active, and produces the vast amounts of plastic substances necessary for the formation and growth of the caryopses; during this process it consumes a large quantity of water. Between the heading stage and ripening there is on an average an interval of 40 days, and during these 40 days all the growth processes are abridged, the later stages following one another rapidly—flowering, setting, and the development and ripening of the caryopses.